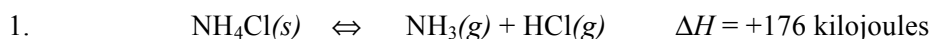


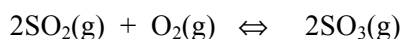
EQUILIBRIUM HMWK



Suppose the substances in the reaction above are at equilibrium at 600K in volume V and at pressure P. State whether the partial pressure of $\text{NH}_3(g)$ will have increased, decreased, or remained the same when equilibrium is reestablished after each of the following disturbances of the original system. Some solid NH_4Cl remains in the flask at all times. Justify each answer with a one-or-two sentence explanation.

- (a) A small quantity of NH_4Cl is added.
- (b) The temperature of the system is increased.
- (c) The volume of the system is increased.
- (d) A quantity of gaseous HCl is added.
- (e) A sample of inert gas (He) is added to the container.
- (f) A catalyst is added to the system.
- (g) What will happen to the mass of $\text{NH}_4\text{Cl}(s)$ when the volume of the container is decreased?
- (h) The $\text{NH}_4\text{Cl}(s)$ is pulverized.
- (i) What will happen to the mass of $\text{NH}_4\text{Cl}(s)$ when the temperature is decreased?
- (j) Predict the sign for the change in entropy. Explain
- (k) Will this reaction be spontaneous at high or low temperatures? Explain.
- (l) Predict the magnitude of K at a high temperature. Explain.
- (m) What is the relationship between K_p and K_c ?

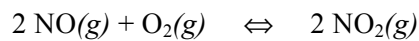
2.



For the above reaction at 727°C , K_c is 2.8×10^2 .

- (a) Predict the sign of ΔS° for the reaction and justify your answer.
- (b) What is the sign for ΔG for the reaction. Justify your answer.
- (c) What is the sign for ΔH° for the reaction. Explain your answer.
- (d) Calculate K_p for this reaction.
- (e) What is the value of ΔG° at 727°C ?
- (f) If 0.40 mole SO_2 , 0.18 mole O_2 , and 0.72 mole SO_3 are mixed in a 2.50 liter container at 727°C , which direction will the net reaction occur?
- (g) If 8.000 grams of SO_3 are injected into an empty 2.50 L container, 0.32 g of oxygen is found at equilibrium at a different temperature. Calculate the new K_c and K_p .
- (h) Is the new temperature higher or lower than 727°C . Explain your answer.

3.



For the reaction above, the rate constant at 380°C for the forward reaction is 2.6×10^3 liter²/mole²-sec and this reaction is first order in O₂ and second order in NO. The rate constant for the reverse reaction at 380°C is 4.1 liter/mole-sec and this reaction is second order in NO₂.

- (a) Write the equilibrium expression for the reaction as indicated by the equation above and calculate the numerical value for the equilibrium constant at 380°C.
- (b) What is the rate of the production of NO₂ at 380°C if the concentration of NO is 0.0060 mole/liter and the concentration of O₂ is 0.29 mole/liter?
- (c) The system above is studied at another temperature. A 0.20 mole sample of NO₂ is placed in a 5.0 liter container and allowed to come to equilibrium. When equilibrium is reached, 15% of the original NO₂ has decomposed to NO and O₂. Calculate the value for the equilibrium constant at the second temperature.

4. Answer the following questions relating to the solubility of the chlorides of silver and lead.

At 10°C, 8.9×10^{-5} g of AgCl(s) will dissolve in 100. mL of water.

- (a) Write the equation for the dissociation of AgCl(s) in water.
- (b) Calculate the value of the solubility-product constant, K_{sp}, for AgCl(s) at 10°C.
- (c) Calculate the molar solubility of AgCl in the presence of 95.3 grams of MgCl₂ dissolved in 250. mL of solution.

At 25°C, the value of K_{sp} for PbCl₂(s) is 1.6×10^{-5} and the value of K_{sp} for AgCl(s) is 1.8×10^{-10} .

- (a) Calculate the molar solubility of PbCl₂(s).
- (b) Calculate the equilibrium value of [Pb²⁺(aq)] in 500. mL of saturated PbCl₂ solution to which 0.250 mole of NaCl(s) has been added. Assume that no volume change occurs.
- (c) If 60.0 mL of 0.0400 M BaCl₂(aq) is added to 60.0 mL of 0.0300 M Pb(NO₃)₂(aq), will a precipitate form? Assume that volumes are additive. Show calculations to support your answer.
- (d) If 0.100 M NaCl(aq) is added slowly to a beaker containing both 0.120 M AgNO₃(aq) and 0.150 M Pb(NO₃)₂(aq) at 25°C, which will precipitate first, AgCl(s) or PbCl₂(s)? Show calculations to support your answer.
- (e) What will be the concentration and percent of the cation first precipitated when the second cation starts to precipitate?
- (f) Is the dissolving of silver chloride endothermic or exothermic? Explain your answer.